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PHYSICAL AND CHEMICAL OCEANOGRAPHIC DATA OBTAINED IN THE LABRADOR SEA DURING ELTANIN CRUISE 2

by

Saul Friedman and Paul Greenough

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During March and April 1962, the USNS ELTANIN occupied nine hydrographic stations in the Labrador Sea during the latter part of the winter season. The positions of the stations are shown in Figure 1.

Temperature measurements were made using Kahlsico, and Richter and Wiese deep-sea reversing thermometers. The Kahlsico thermometers were calibrated at the U. S. Navy Oceanographic Office, and the latter at the Physikalisch-Technische Bundesanstalt.

Salinity determinations were made with model 601 MK III inductive salinometer developed by Hamon and Brown, and manufactured by Auto-Lab Industries, Australia. A serious problem in drift due to entrapped air bubbles was encountered. This problem of air bubbles was due to the design of the stirring blade and was corrected by rounding off its edges and sharp corners. A test of the instrument's reproducibility was made by filling a 500 ml narrow-necked volumetric flask with sea water and homogenizing it, using a magnetic stirrer. The salinometer's cell was flushed many times with this water. The results of seven consecutive salinity determinations are shown in Table 1.

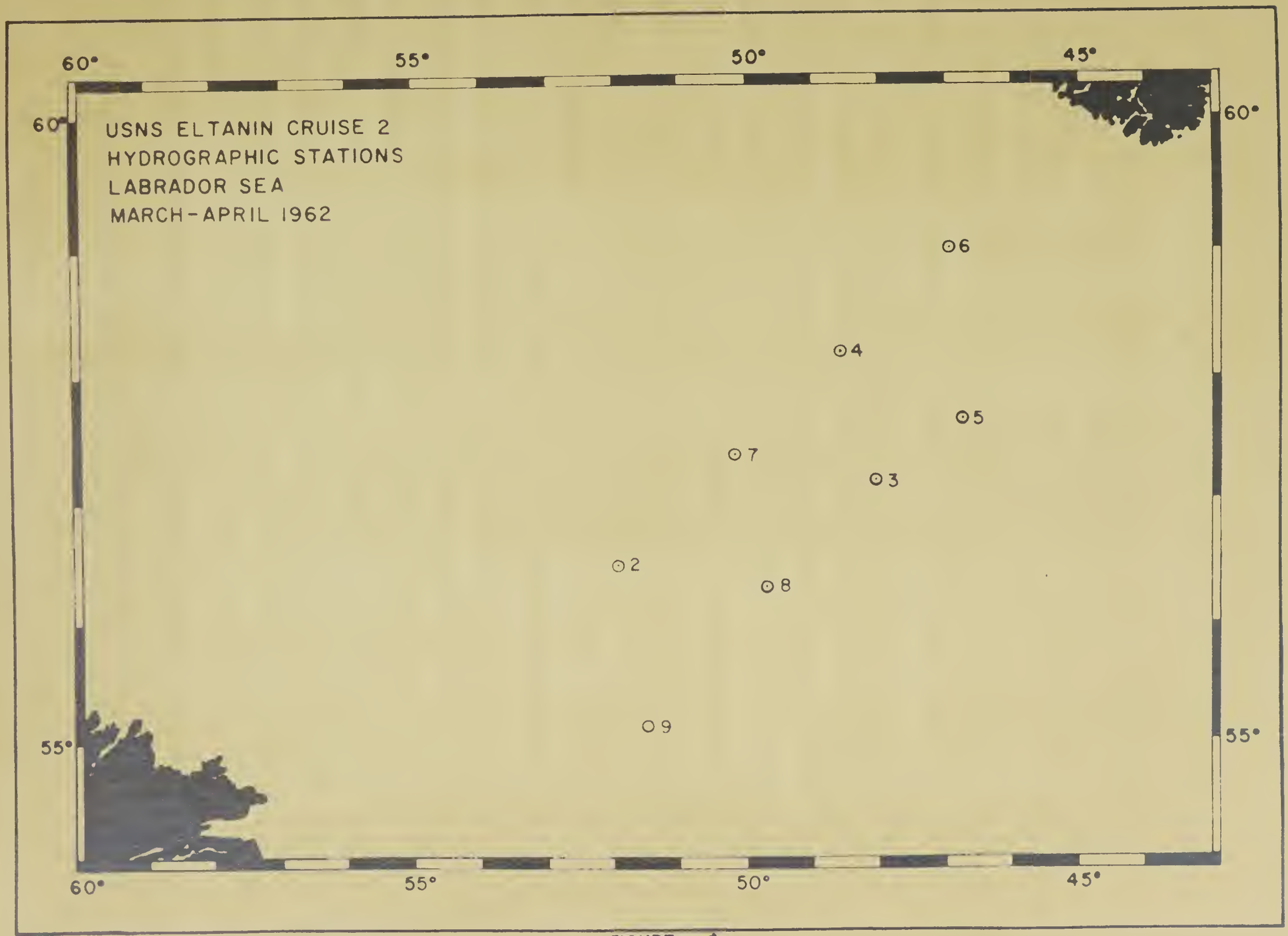

60°
55°
50°
45°
60°
USNS ELTANIN CRUISE 2
HYDROGRAPHIC STATIONS
LABRADOR SEA
MARCH-APRIL 1962
6
4
5
7
3
2
8
9
55°
60°
55°
50°
45°

FIGURE 1

TABLE 1

	33.816
	33.821
	33.822
	33.823
	33.824
	33.824
	33.825
Average	33.822

With the exception of the first determination, the reproducibility appears to be affected principally by evaporation between consecutive analyses. The cell is loaded through a polyethylene tube whose outer diameter is slightly less than the inner diameter of the long-necked volumetric flask. The 50 ml sample is drawn in with a vacuum pump and after the measurement (which takes less than thirty seconds) the sample is allowed to drain back into the flask. The polyethylene tube remains immersed in the flask at all times. It appears that there is a change in salinity of approximately 0.001 o/oo between each sample analysis, apparently due to evaporation.

Standardization of the salinometer is done against Copenhagen standard water. Generally three to five determinations are made from one vial. After the cell has been flushed several times, the sample is allowed to flow back into the vial between measurements. The standardization data is listed in Table 2.

TABLE 2

Station	Standardization Ratio	Δ Ratio	ΔRatio^2	Mean Deviation+
2	6542	0	0	
	6542	0	0	
	average 6542		0	± 0.000
2	6528	-12	144	$\sqrt{\frac{288}{2}} = 12$
	6552	+12	144	
	6540	0	0	
	average 6540		288	± 12* ≅ ± 0.004 o/oo
2	6542	+ 1	1	$\sqrt{\frac{253}{4}} = 8$
	6542	+ 1	1	
	6528	-13	169	
	6552	+ 9	81	
	6540	- 1	1	
	average 6541		253	± 8* ≅ 0.002 o/oo
3	6553	+ 5	25	
	6542	- 6	36	$\sqrt{\frac{1807}{4}} = 21$
	6536	-12	144	
	6536	-12	144	
	6575	27	729	
	average 6548		1807	± 21* ≅ 0.006 o/oo
4	6712	- 1	1	$\sqrt{\frac{855}{4}} = 15$
	6732	+18	324	
	6715	+ 2	4	
	6704	- 9	81	
	6702	-11	121	
	average 6713		855	± 15* ≅ 0.004 o/oo
6	6741	+ 5	25	
	6744	+ 8	64	$\sqrt{\frac{285}{2}} = 12$
	6722	-14	196	
	average 6736		285	±12* ≅ 0.004 o/oo
8	6716	- 5	25	$\sqrt{\frac{285}{2}} = 12$
	6735	+14	196	
	6713	- 8	64	
	average 6721		285	± 12* ≅ 0.004 o/oo

* The last digit was found to affect a salinity by approximately 0.0003 o/oo. This was determined by filling the cell with water of a known salinity, then shifting the standardization dial one unit and adjusting the bridge with the conductivity ratio dials until the instrument balanced.

+ Mean deviation= $\sqrt{\frac{\text{ratio}^2}{n-1}}$

As can be seen from Table 2, the standard deviation is = 0.004 o/oo with reference to a chlorinity standard, when using Copenhagen standard water as a reference solution. These results are not consistent with the results obtained using a homogeneous water sample. Salinity determination obtained on a later cruise using the same instrument and using one liter of homogeneous sea water in a wide-mouthed jar, yielded the following results as shown in Table 3.

TABLE 3

Conductivity Ratio	Salinity o/oo	Salinity o/oo	Salinity^2 o/oo	
96892	33.782	0.005	0.000025	
96890	33.781	0.004	0.000016	
96846	33.764	-0.013	0.000169	
96867	33.772	-0.005	0.000025	
96891	33.781	0.004	0.000016	std.dev.=
96886	33.779	0.002	0.000004	
96881	33.771	-0.006	0.000036	
96891	33.781	0.004	0.000016	
96900	33.785	0.008	0.000064	$=\sqrt{\frac{0.000404}{12}}$
96876	33.775	-0.002	0.000004	
96870	33.773	-0.004	0.000016	
96888	33.780	0.003	0.000009	= 0.000034
96886	33.779	0.002	0.000004	
	33.777		= 0.000404	= ±.006 o/oo

As can be seen, the standard deviation of the machine and operator is ± 0.006 o/oo. It will be noted in Figure 2 that the spread of values on the T-S diagram in the deep water is on the average ± 0.006 o/oo from the mean. In summary, it appears that with extreme caution one can obtain reproducible results within 0.001 o/oo under controlled conditions using a

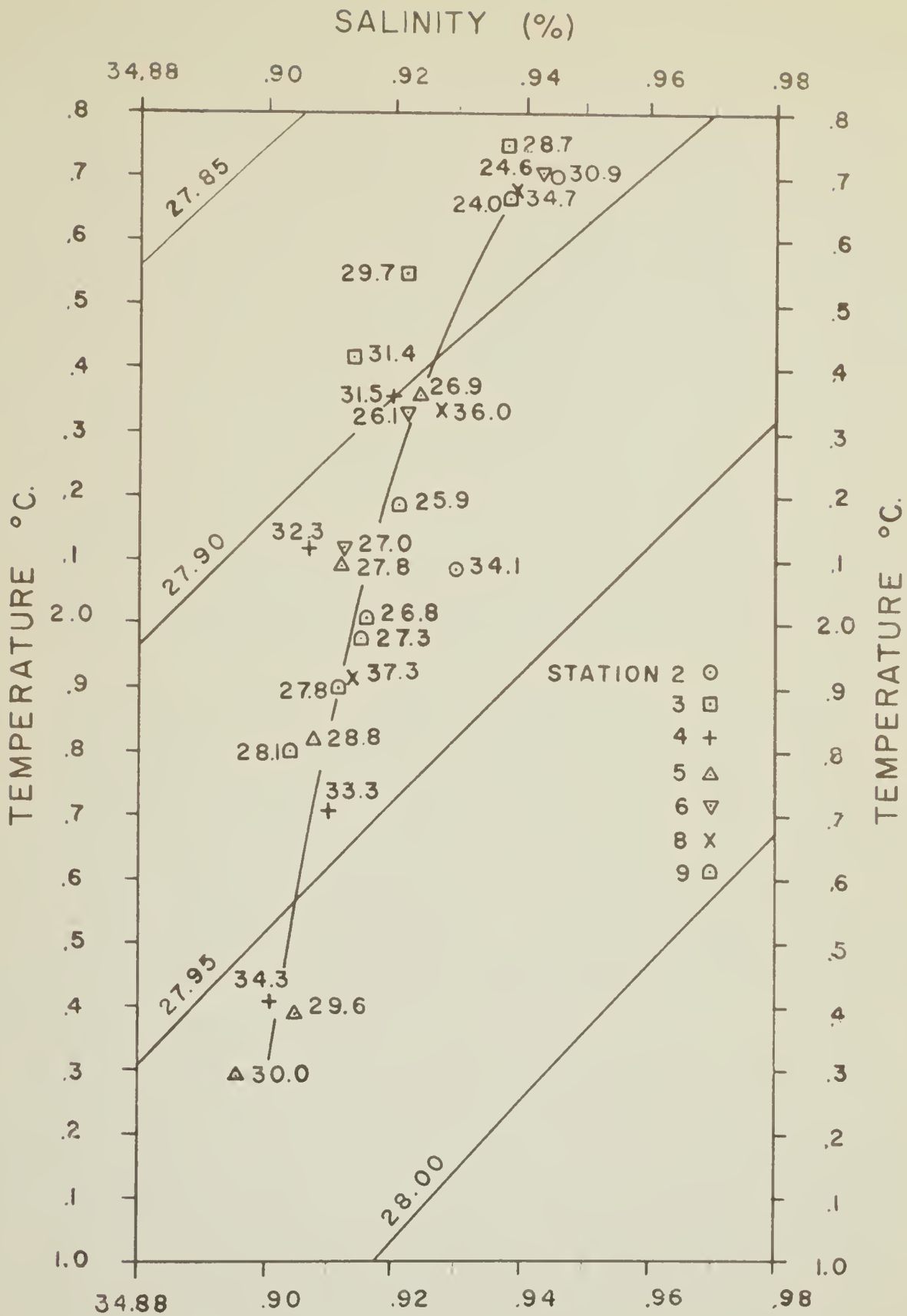


DIAGRAM OF T-S RELATIONSHIPS IN THE DEEP WATERS OF THE LABRADOR SEA.
(depths in hectometers)

Fig. 2

large volume of water. In practice it appears that an accuracy of ± 0.006 o/oo is more realistic. The deviation of ± 0.004 o/oo, when standardizing, sets the absolute accuracy of the instrument, provided that the conductivity:chlorinity ratio presently being used is valid. It is therefore estimated that the salinity values have a maximum error of ± 0.010.

Dissolved Oxygen Analysis

Dissolved oxygen determinations were made using a modified Winkler titration method, utilizing approximately 0.01N $Na_2S_2O_3$ as titer for released free I_2, with careful standardization against 0.01N $KH(IO_3)_2$ solution. Reagent blanks were run in order to monitor any reagent contamination. An automatic burette and a magnetic stirring device were used, assuring uniformity of technique under shipboard conditions. The O_2 samples were drawn immediately from the Teflon-lined Nansen bottles, quickly treated, and kept in the dark until titration.

Titrations were performed upon the samples until two values were within 0.03 ml of each other (±0.015 ml from average), and standardization values varied less than 0.01 ml of thiosulfate in all cases. Thus variation, in total, amounted to 0.03 ml of thiosulfate in all determinations. The estimated error is ± 0.03 ml/l of dissolved oxygen.

Nitrate Determination

Sea water samples were drawn from Nansen bottles, measured to 50 ml and buffered to a pH of 9.6 (NaOH-phenol) while at constant temperature in a water bath. Nitrate in sea water is reduced by hydrazine, in the presence of cupric ion as a catalyst, to nitrite. The nitrite formed -- along with naturally occurring nitrite -- is determined by diazotizing with sulphanilamide and coupling with N-(1-napthyl)-ethylenediamine hydrochloride to form a red dye. The method is carefully described by Strickland, et al. (1960).

A Beckman model Du spectrophotometer is used for analysis, using 1 cm cells at a wavelength of 543 millimicrons. Calibration of the instrument is performed before each station is analyzed, using known concentration of nitrate dissolved in synthetic sea water which has an approximate salinity of 31 o/oo. This eliminates a salt error correction. The estimated error for concentrations at the 30 level is ± 1.3ug-AT/l, using a one centimeter cell and ± 4.5 ug AT/l using a 10 centimeter cell.

Phosphate Determination

Reactive, inorganic phosphate was determined with the technique described by Strickland, et al., using a Beckman Du model spectrophotometer. Samples, standards and blanks were treated with an acidified ammonium molybdate solution and the phospho-molybdate complex formed was reduced with stannous chloride.

The blue solution resulting was measured after ten minutes in a ten centimeter cell at 700 millimicrons. The standard phosphate solutions were derived from KH_2PO_4 stabilized with chloroform. Standards and blanks were made with synthetic sea water of 28 o/oo salinity, to obviate salt errors. Samples were analyzed within twenty hours of collection. The accuracy is estimated at ± 0.11 ug AT/l for high (ca. 3.00 ug AT/l) concentrations, and ± 0.06 ug AT/l for low (ca. 0.3 ug AT/l) concentrations.

Silicate

Dissolved, reactive silicate is determined as described by Mullins and Riley in a spectrophotometer by comparison with standard silicate solutions. Samples and standards are treated with 6N H_2SO_4 and an $(NH_4)_6Mo_7O_{24}.4H_2O$ solution, resulting in a yellow-colored silico-molybdic acid solution. After waiting 15 minutes for full color formation, the solutions are read at 404 millimicrons in a Beckman model Du spectrophotometer using primarily 10 cm cells and occasionally 1 cm cells for high concentrations. The silicate standard solution is prepared from fused silicic acid, and dissolved with sodium carbonate, as described by Strickland, et al. By making up standards and blanks with a synthetic sea water (28 o/oo), salt error variation is eliminated.

All reactions are carried out in polyethylene bottles to prevent silicate leaching from glass, and analyzed within twenty hours from the time the sample was collected. The estimated error is ±0.25 ug AT/l for low concentrations at the

10 ug AT/l level using the 10 cm cells and ± 2.5 ug AT/l for 1 cm cells at the 100 ug AT/l level.

The Nansen bottles that were used had a 1500 cc capacity. The inside of the Nansen bottles were Teflon-coated and the bottles had removable heads which facilitated cleaning out any possible contaminants.

The station lists follow and give the data obtained. It should be noted that:

1. The latitude and longitude are the position of the station when the shallow cast was tripped.

2. The time is local time and indicates true time at which the messenger was sent on the shallow cast.

3. The sonic depth for each station was obtained by use of the precision depth recorder, and the PDR value corrected using Matthews' tables (Matthews, 1939).

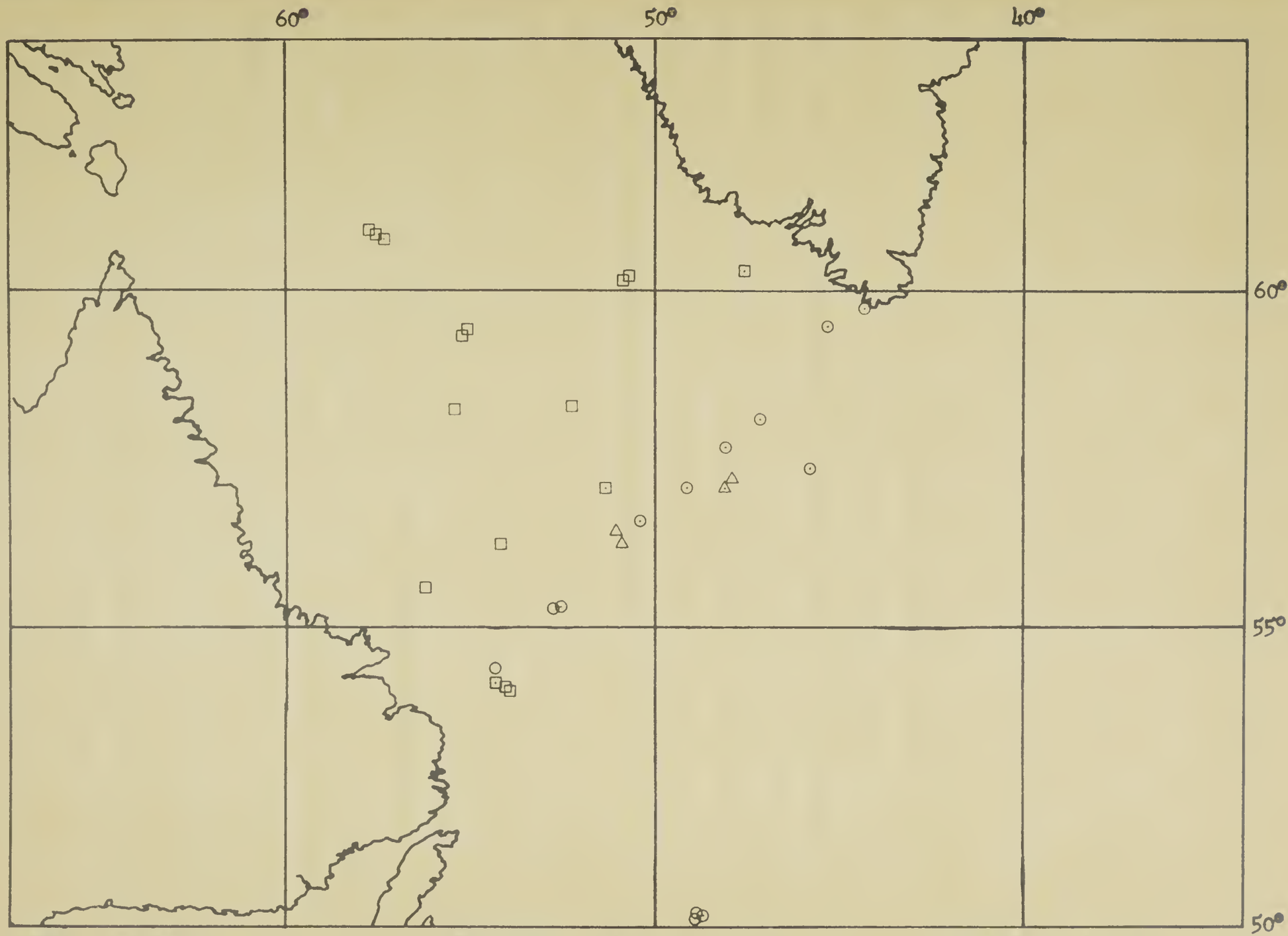
4. The wire angle is the wire angle when the messenger was released.

5. A break in the figure listing indicates that two or more casts were taken at that station.

6. The observed depths marked with an asterisk are thermometric depths obtained with an unprotected thermometer. The accuracy of the thermometric depths is estimated to be better than ± 10 meters.

7. The accuracy of the deep-sea reversing thermometer is estimated to be ± 0.02°C.

During Cruise 2 of the research vessel ELTANIN, in the area between Labrador and Greenland, four large volume water samples were obtained for radiocarbon analysis. Three subsurface and one surface sample were collected in the central Labrador Sea area. These new collections represent about 12% of the total samples available for this region. However, they represent 100% of the samples collected during the winter season, which is an important time in the formation of dense surface water which may be carried down through deep-reaching convective processes to influence the deep water of the western North Atlantic between 1500 and 3500 meters depth. These samples have been returned to the Lamont laboratory and are being processed for radiocarbon measurement along with the other collections made in the Subarctic shown in Figure 3. The samples were collected using a Lamont large-volume water sampler (55 gallons) similar to that described by Gerard and Ewing (1961). Water from the sampler is pumped to a plastic processing tank where it is acidified with H_2SO_4 and bubbled into a closed system with CO_2-free air. The CO_2 released to the gas phase is absorbed on 5 normal purified KOH held in two one-liter bubblers operated in series. Recovery of more than 80% of the CO_2 from a 220-liter sample takes about three hours. The recovery is monitored by means of a titration technique. The KOH bubblers are returned to the laboratory where the solution is acidified and the CO_2 is released. The CO_2 is purified by absorption and desorption from



SUBARCTIC RADIOCARBON SAMPLES

FIGURE 3

CaO contained in quartz tubes and is then assayed for radioactivity in a 5-liter proportional counter. The precision of the C^{14} assay ranges from .5 to 1%. Details of the shipboard and laboratory techniques are reported by Broëcker, et al (1960)

Acknowledgments

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References

Broecker, W. S., R. Gerard, M. Ewing, and B. C. Heezen (1960) Natural radiocarbon in the Atlantic Ocean; Jour. Geophys. Res., v. 65, no. 9, p. 2903-2931.

Brown, N. L., and B. V. Hamon (1961) An inductive salinometer; Deep-Sea Res., v. 8, no. 1, p. 65-75.

Gerard, R., and M. Ewing (1961) A large-volume water sampler; Deep-Sea Res., v. 8, no.3/4, p. 298-301.

Matthews, D. J. (1939) Tables of the velocity of sound in pure and sea water for use in echo-sounding and sound ranging; H. O. 282, Hydrogr. Dept., Admiralty, London.

Mullin, J. B., and J. P. Riley (1955) The colorimetric determination of silicate with special reference to sea and natural waters; Analy. Chim. Acta, 12, p. 162-176.

Strickland, J. D. H., and T. R. Parsons (1960) A manual of sea water analysis; Bulletin No. 125, Fisheries Res. Bd. Canada, Ottawa.

STATION NO. 1 LATITUDE 51°-29' N LONGITUDE 48°-30' W
DATE 23 March 1962 TIME 13:00 SONIC DEPTH 3315 M
WIRE ANGLE: SHALLOW CAST 10° DEEP CAST 13°

Depth (M)	T (°C)	Salinity (o/oo)	σ_t (g/l)	Si	No3-N	PO4-P
				(µg-at/l)		
0	4.2	34.637	27.50	10.8	26.0	0.68
25	4.21	34.646	27.50	12.1	28.4	0.69
50	4.21	34.630	27.49	9.2	25.6	0.85
75	4.26	34.677	27.52	15.0	28.9	0.68
100	-	34.685	-	14.5	29.7	0.75
150	3.81	34.747	27.63	12.7	32.2	0.89
200	3.51	34.776	27.68	9.2	33.5	-
300	3.26	34.800	27.72	7.6	33.2	0.59
400*	3.23	34.821	27.74	10.1	36.2	0.97
500	3.31	34.828	27.74	16.3	32.0	-
600	3.39	34.858	27.76	9.3	35.2	1.00
800	3.41	34.[illegible]7?	27.75	13.5	33.2	1.04
1000	3.42	34.871	27.76	14.2	34.3	1.01
1243*	3.47	34.877	27.76	15.2	33.8	0.96
1503*	3.46	34.908	27.79	18.2	37.3	0.95
1752*	-	34.914	-	18.8	35.6	0.91
2002	3.31	34.886?	27.79	15.9	-	0.87
2254*	3.10	34.910	27.83	14.2	35.8	0.74
2502	2.85	34.914	27.85	14.9	33.0	1.06
2750	2.56	34.914	27.88	14.6	3[illegible].6	1.13
2997	2.07	34.910	27.92	10.0	31.1	0.97
3241*	2.04	34.902	27.91	9.5	28.9	0.93
3312	1.91	34.898	27.92	14.5	31.6	0.72

STATION NO. 2
DATE 29 March 1962
WIRE ANGLE:

LATITUDE 36 28° N
TIME 21:30 local
SHALLOW CAST 25°

LONGITUDE 22 36° W
SONIC DEPTH 3532 M
DEEP CAST 40°

Depth (M)	T (°C)	Salinity (o/oo)	σ_t (g/l)	O_2 (ml/l)	Po4-P
0	3.2	34.774	27.71	5.86	1.13
19	3.27	34.792	27.72	7.10	0.83
40	3.28	34.792	27.71	6.79	0.75
61	3.27	34.790	27.71	7.04	1.08
83*	3.23	34.789	27.72	7.00	0.90
130	3.19	34.800	27.73	7.18	0.81
178	3.21	34.827	27.75	6.83	1.04
264*	3.22	34.814?	27.74?	6.83	0.93
370	3.32	34.860	27.76	6.65	1.18
464	3.38	34.872	27.77	6.69	1.11
559	3.36	34.878	27.78	-	1.10
750	3.36	34.884	27.78	6.62	0.94
940*	3.33	34.879	27.78	-	1.02
904	3.35	34.885	27.78	6.64	-
1136*	3.36	34.894	27.79	6.70	1.07
1373*	3.33	34.896	27.79	6.64	0.93
1742	3.45	34.908	27.79	6.38	1.03
1852*	3.44	34.920	27.80	6.35	1.05
2090	3.37	34.938	27.82	6.42	-
2321*	3.25	34.950	27.84	-	1.12
2572	3.12	34.943	27.85	6.38	-
2828*	2.98	34.947	27.87	6.36	1.20
3093	2.70	34.945	27.89	6.35	1.05
3410*	2.09	34.930	27.93	6.61	0.24

STATION NO. 3 | LATITUDE 5[illegible]°N | LONGITUDE [illegible]°W
DATE 1 April 1962 | TIME [illegible] local | SONIC DEPTH 3532 M
WIRE ANGLE: | SHALLOW CAST 10° | DEEP CAST 55°

Depth (M)	T (°C)	Salinity (o/oo)	σ_t (g/l)	Si	NO_3-N	PO_4-P
				(µg-at/l)		
0	4.1	34.934	27.74	12.1	23.8	0.97
21	3.99	34.933	27.76	"	"	"
46	4.01	34.934	27.75	14.1	23.0	0.92
71	4.01	34.933	27.75	11.2	19.0	0.97
95	4.00	34.934	27.75	10.8	25.1	0.86
143	3.99	34.937	27.76	9.7	24.2	1.06
195	4.02	34.929	27.75	12.9	23.6	1.06
295	3.94	34.931	27.76	-	23.6	1.03
394	3.91	34.930	27.76	-	24.8	1.09
494	3.87	34.927	27.76	11.5	22.0	0.82
694	-	34.898	-	-	23.8	0.82
893	3.57	34.880	27.76	10.9	24.9	0.96
1093*	3.48	34.882	27.77	14.6	24.0	1.06
1702*	3.49	34.899	27.78	16.1	25.6	1.15
1894*	3.44	34.908	27.79	15.2	26.4	0.93
2077	-	34.910	-	15.4	24.9	1.08
2263*	3.23	34.914	27.82	17.1	25.4	1.01
2443*	3.13	34.914	27.82	15.6	26.8	0.97
2555	2.94	34.922	27.85	11.1	19.2	1.01
2866*	2.75	34.938	27.88	19.0	25.4	1.11
2972	2.55	34.922	27.88	21.0	26.8	0.96
3143*	2.42	34.914	27.89	22.1	25.1	1.08
3311	1.43	-	-	-	24.0	-
3459*	1.39	-	-	-	-	-

STATION NO. 4
DATE 3 April 1962
WIRE ANGLE: . .

LATITUDE 58-14 N
TIME CO:20 local
SHALLOW CAST 37

LONGITUDE 48-36 W
SONIC DEPTH 3473 M
DEEP CAST 65

Depth (M)	T (C)	Salinity (o/oo)	t (g/l)	2 (ml/l)	Si	No3-N	Po4-P
					(g-at/l)		
0	3.6	34.812	27.70	7.28	12.6	20.2	0.84
17	3.20	-	-	-	-	-	-
39	3.22	34.813	27.74	-	10.8	23.1	1.03
59	3.20	34.809	27.74	-	9.7	23.8	0.78
78	3.22	34.810	27.74	-	11.1	23.1	0.85
116	3.25	34.824	27.74	-	11.2	23.9	0.77
154	3.30	-	-	-	12.6	21.8	0.86
232	3.59	34.890	27.76	-	14.1	24.3	0.79
309*	3.55	34.893	27.77	-	9.7	15.2	0.85
389	3.44	34.886	27.77	-	14.0	14.4	0.93
559	3.43	34.872	27.76	-	-	11.7	0.88
742	3.41	34.885	27.78	-	15.3	12.7	1.03
932	3.35	34.876	27.77	-	-	21.3	0.91
1186	3.35	34.873	27.77	6.82	-	25.6	0.95
1278*	3.35	34.874	27.77	6.71	10.6	22.2	0.88
1398*	3.36	34.873	27.77	6.73	-	25.9	0.96
1665*	3.47	34.882	27.77	6.64	19.2	25.7	0.93
1804*	3.48	34.922	27.80	6.53	13.9	27.3	0.89
1932	3.42	34.922	27.80	6.38	13.0	18.6	0.97
2073	3.35	34.929	27.82	6.50	17.7	11.2	1.10
2211	3.28	34.937	27.83	6.13	18.5	17.0	0.88
2381*	3.17	34.932	27.84	5.76	14.3	24.4	0.86
2571	3.00	34.937	27.86	6.42	-	24.6	1.01
2761*	2.84	34.940	27.87	6.45	-	16.6	0.94
3145*	2.36	34.920	27.90	6.62	-	23.2	-
3234*	2.12	34.907	27.91	6.58	-	20.0	-
3328	1.71	34.910	27.94	6.93	-	22.5	-
3429	1.41	34.901	27.96	6.97	-	19.8	-

STATION NO 5
DATE 4 April 1962
WIRE ANGLE: _____

LATITUDE 57°-42' N
TIME 17:15 local
SHALLOW CAST 45°

LONGITUDE 46°-48' W
SONIC DEPTH 3047 M
DEEP CAST 35°

Depth (M)	T (°C)	Salinity (o/oo)	σ_t (g/l)
0	4.2	34.912	27.72
20	3.96	34.918	27.75
40	3.99	34.935	27.76
61	3.96	34.919	27.75
82	3.99	34.936	27.76
121	4.01	34.933	27.75
158*	3.98	34.931	27.75
245	3.96	34.931	27.76
425*	3.77	34.918	27.77
615	3.57	34.900	27.77
810*	3.53	34.898	27.77
1037*	3.36	34.880	27.78
1390	3.37	34.895	27.79
1617*	3.37	34.929	27.81
1813	3.38	34.933	27.82
2008	-	34.941	-
2204*	3.03	34.943	27.86
2403*	2.84	34.944	27.88
2592	2.59	-	-
2685*	2.36	34.924	27.90
2781	2.09	34.912	27.92
2877*	1.82	34.908	27.93
2963	1.39	34.905	27.96
3002	1.29	34.896	27.96

STATION NO. 6
DATE 5 April 1962
WIRE ANGLE:

LATITUDE 59°-02' N
TIME 10:29
SHALLOW CAST 55°

LONGITUDE 45°-59' W
SONIC DEPTH 2844 M
DEEP CAST 70°

Depth (M)	T (°C)	Salinity (o/oo)	σ_t (g/l)	O_2 (ml/l)	Si	NO_3-N	PO_4-P
					(µ g-at/l)		
0	4.0	34.919	27.74	6.84	13.2	16.9	1.04
13	3.89	34.916	27.75	6.62	13.0	16.0	0.92
30	3.92	34.916	27.75	4.06	12.0	13.4	0.98
45	3.91	34.922	27.76	5.29	13.4	18.6	1.05
59	3.91	34.922	27.76	4.13	12.4	12.0	0.87
88	3.91	34.922	27.76	4.22	13.8	16.0	1.15 ~~11.5?~~
117*	3.90	-	-	5.70	12.4	18.9	0.92
176	3.86	34.913	27.75	5.30	13.9	17.1	1.17 ~~11.7?~~
236*	3.81	34.913	27.76	6.09	12.9	19.3	0.90
289	3.78	34.913	27.76	3.61	13.6	12.2	1.10
413*	3.79	34.918	27.76	6.40	13.1	-	0.80
567	3.74	34.914	27.77	4.39	13.7	16.9	1.10
741*	3.54	34.897	27.77	6.33	13.5	10.6	1.01
902*	3.56	34.894	27.77	4.38	14.8	15.7	0.91
1077	3.40	34.884	27.78	4.77	14.6	21.8	1.06
1252	3.37	34.881	27.78	5.51	15.1	12.6	1.14
1434*	3.38	34.890	27.78	6.37	14.3	16.6	1.10
1602*	3.46	34.923	27.80	5.95	16.5	11.9	1.25
1802	3.37	34.941	27.82	5.80	18.3	20.7	1.23
2004*	3.17	34.944	27.85	6.27	17.2	15.4	1.20
2204	2.96	34.947	27.87	5.71	10.4	11.4	0.88
2463*	2.71	34.943	27.89	5.24	22.1	18.3	1.02
2614	2.33	34.922	27.90	5.99	16.2	10.8	0.88
2696	2.12	34.912	27.91	-	25.8	10.1	1.61

STATION NO. 7
DATE 6 April 1962
WIRE ANGLE:

LATITUDE 57°-25' N
TIME 19:22 local
SHALLOW CAST 55°

LONGITUDE 50°-08' W
SONIC DEPTH 3853 M
DEEP CAST 65°

Depth (M)	T (°C)	Salinity (o/oo)	σ_t (g/l)	O_2 (ml/l)	Si	NO_3-N	PO_4-P
					(µg-at/l)		
0	3.5	34.816	27.71	7.45	-	-	-
15	3.10	34.790	27.73	7.26	14.3	11.4	0.88
31	3.13	34.794	27.73	6.63	14.5	17.4	0.97
48	3.13	-	-	-	-	-	-
66	3.12	34.795	27.73	6.68	14.1	15.9	0.82
83	3.13	34.798	27.73	6.93	13.4	15.8	0.89
118*	3.16	34.799	27.73	6.92	14.5	16.2	0.93
152	3.17	34.816	27.74	6.86	15.5	16.9	-
216	3.27	34.840	27.75	6.66	13.5	17.2	0.83
345*	3.34	34.853	27.76	6.67	16.2	20.6	0.87
485*	3.40	-	-	6.47	-	-	-
652	3.39	34.880	27.77	6.49	14.6	14.6	0.97
850*	3.36	34.884	27.78	6.76	-	-	-
889*	3.35	34.876	27.78	6.74	-	17.2	-
1124	3.31	34.882	27.78	6.63	-	11.4	-
1345	3.31	34.878	27.78	6.75	15.2	17.9	0.95
1572*	3.31	34.878	27.78	6.77	15.3	4.9	0.96
1773*	3.34?	34.883	27.78	6.56	16.2	18.5	1.01
2000	2.97	34.919	27.85	6.56	-	20.0	-
2279*	2.94	34.944	27.87	6.39	19.2	12.9	0.98
2616	2.83	34.948	27.88	6.39	20.2	20.0	1.06

STATION NO. 8
DATE 7 April 1962
WIRE ANGLE:

LATITUDE 56° 19.5' N
TIME 20:25 local
SHALLOW CAST 10°

LONGITUDE 49° 43' W
SONIC DEPTH 3749 M
DEEP CAST 10°

Depth (M)	T (°C)	Salinity (o/oo)	σ_t (g/l)
0	4.38	34.803	27.6861
24	3.04	34.801	27.74
47	3.08	34.806	27.74
71	3.07	34.808	27.75
95	3.05	34.807	27.75
141	3.06	34.802	27.74
188*	3.10	34.808	27.74
287	3.02	34.827	27.77
386	3.02	34.835	27.77
487*	3.0	34.843	27.78
690	[illegible]	34.848	27.78
894*	3.06	34.843	27.78
661	[illegible].06	34.853	27.78
1027*	3.06	34.849	27.78
1381	3.10	34.839	27.77
1724*	3.14	34.839	27.77
2085	3.23	34.871	27.78
2441	3.28	34.872?	27.78
2796*	3.33	34.942	27.83
3141	2.98	34.950	27.87
3470*	2.68	34.939	27.89
3599	2.34	34.927	27.91
3726	1.29	34.914	27.93

STATION NO. 9
DATE 8 April 1962
WIRE ANGLE: _____

LATITUDE 55°-07' N
TIME 09:23 local
SHALLOW CAST 17m

LONGITUDE 51°-27' W
SONIC DEPTH 2820 M
DEEP CAST 30m

Depth (M)	T (°C)	Salinity (o/oo)	σ_t (g/l)	O_2 (ml/l)	Si (µg-at/l)	PO4-P (µg-at/l)
0	4.99	34.750	27.55	6.96	-	-
25	3.18	34.741	27.68	7.13	12.4	1.03
49	3.10	34.743	27.69	7.12	1.04	0.95
74	3.01	-	-	7.02	-	1.04
98	-	34.797	-	6.82	10.8	1.05
196	3.05	34.804	27.74	6.91	10.7	0.91
292*	3.40	34.874	27.77	6.44	12.2	0.87
390	3.42	34.875	27.77	6.44	11.2	1.10
491	3.42	34.885	27.78	6.69	15.4	1.01
693*	3.43	-	-	5.89	-	-
898	3.41	34.924?	27.81?	6.34	-	-
1105*	3.36	34.899	27.79	6.49	12.5	0.95
1190*	3.35	34.898	27.79	-	12.9	0.99
1333	3.43	34.917	27.80	-	16.0	0.96
1531*	3.39	34.929	27.81	-	11.5	1.09
1774	3.32	34.937	27.83	-	12.8	0.89
2017*	3.15	34.946	27.85	-	17.4	1.11
2210*	2.88	34.937	27.87	-	18.5	1.12
2402	2.67	34.938	27.89	-	15.4	0.98
2591*	2.19	34.921	27.91	6.87	15.9	0.93
2684	2.01	34.916	27.92	6.36	14.8	0.96
2731*	1.98	34.915	27.94	6.24	14.6	0.99
2783	1.90	34.911	27.94	-	16.3	0.97
2805*	1.80	34.904	27.93	-	14.4	0.93